

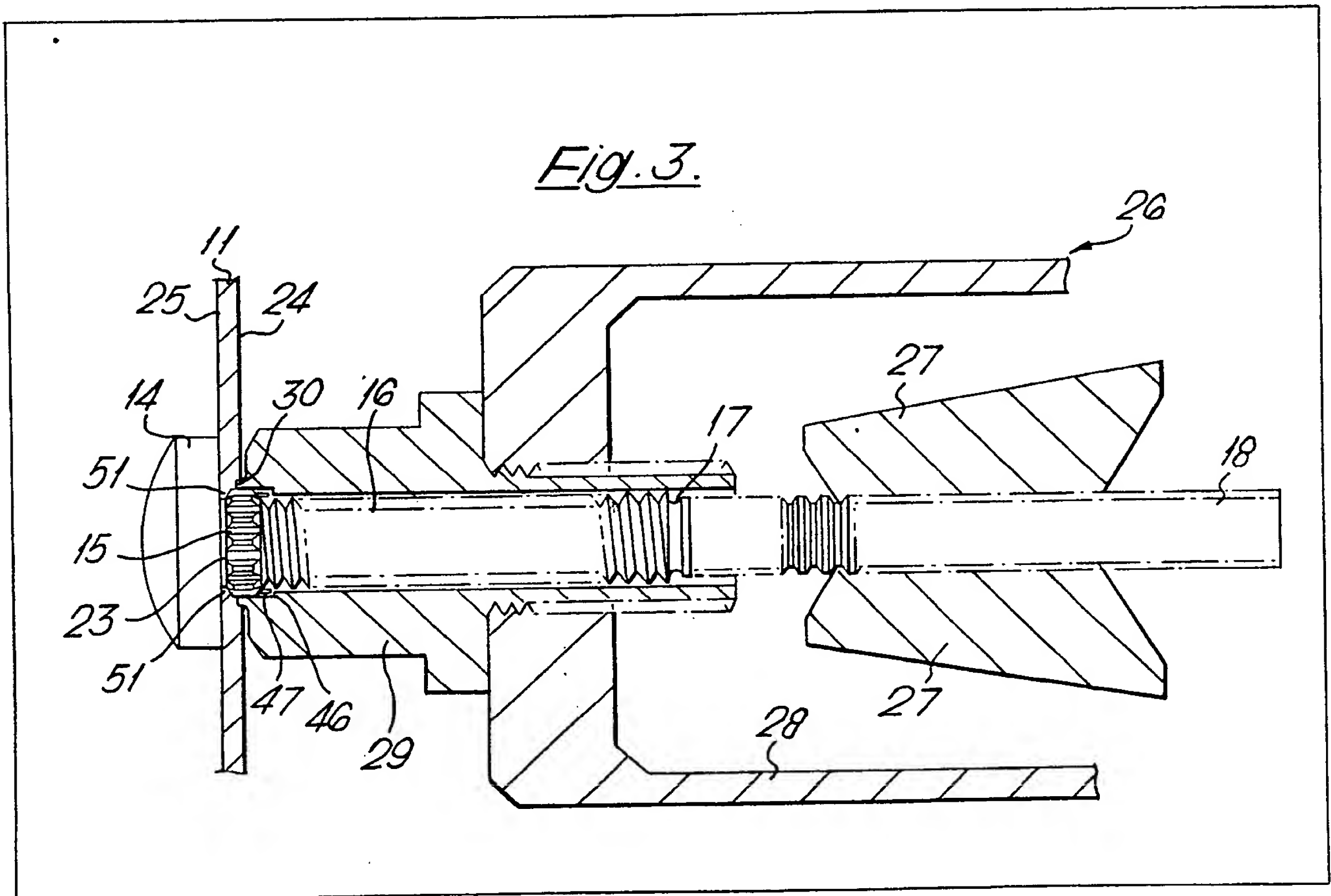
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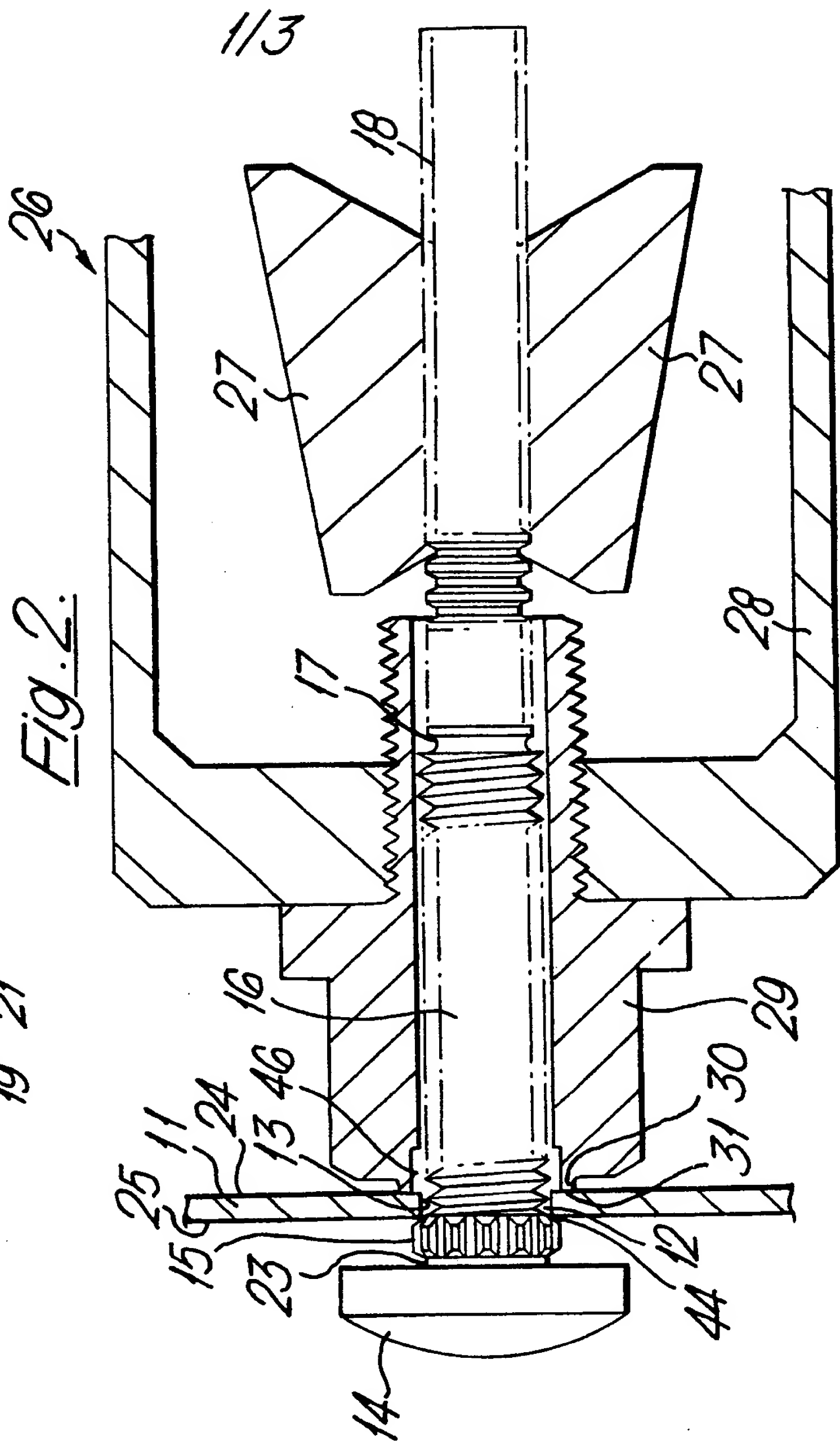
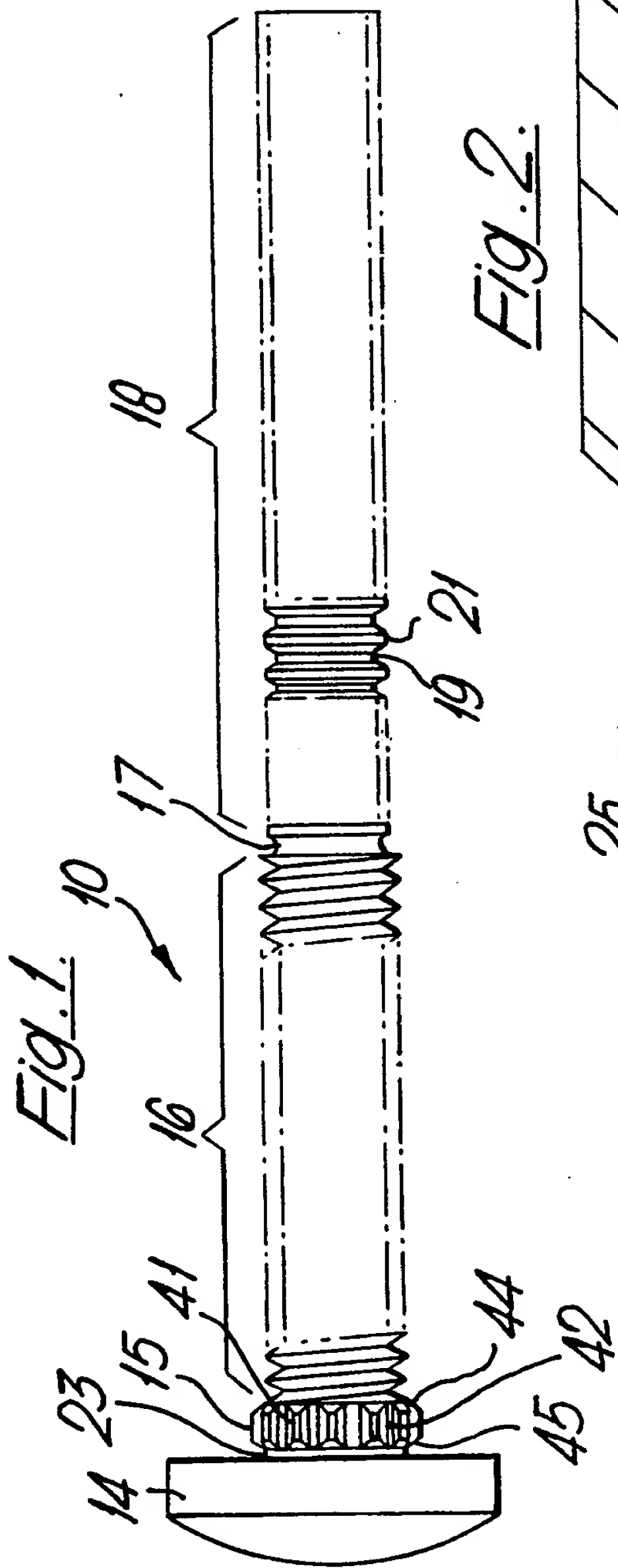
- (54) Electrically conductive pin and method of installation thereof**

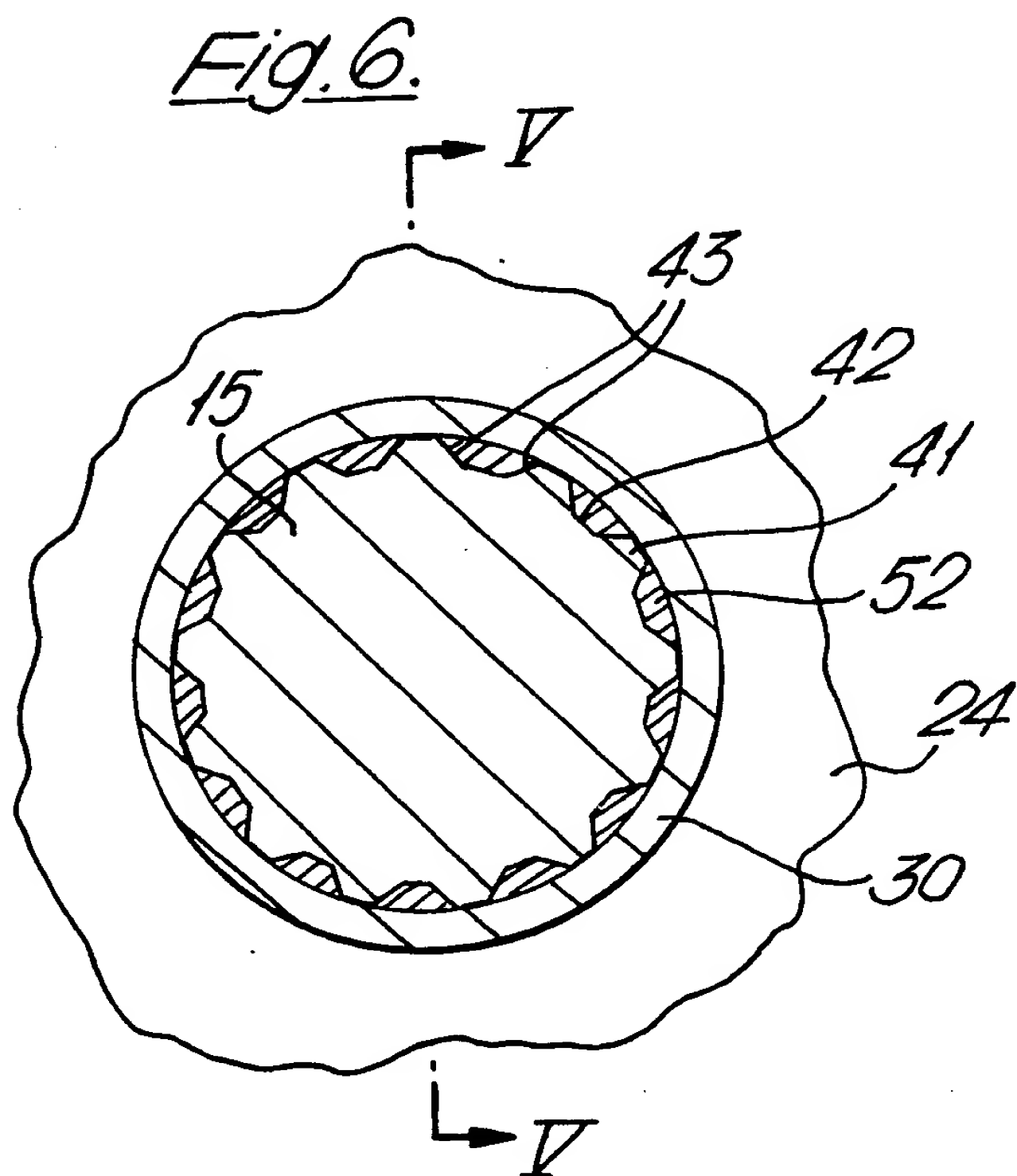
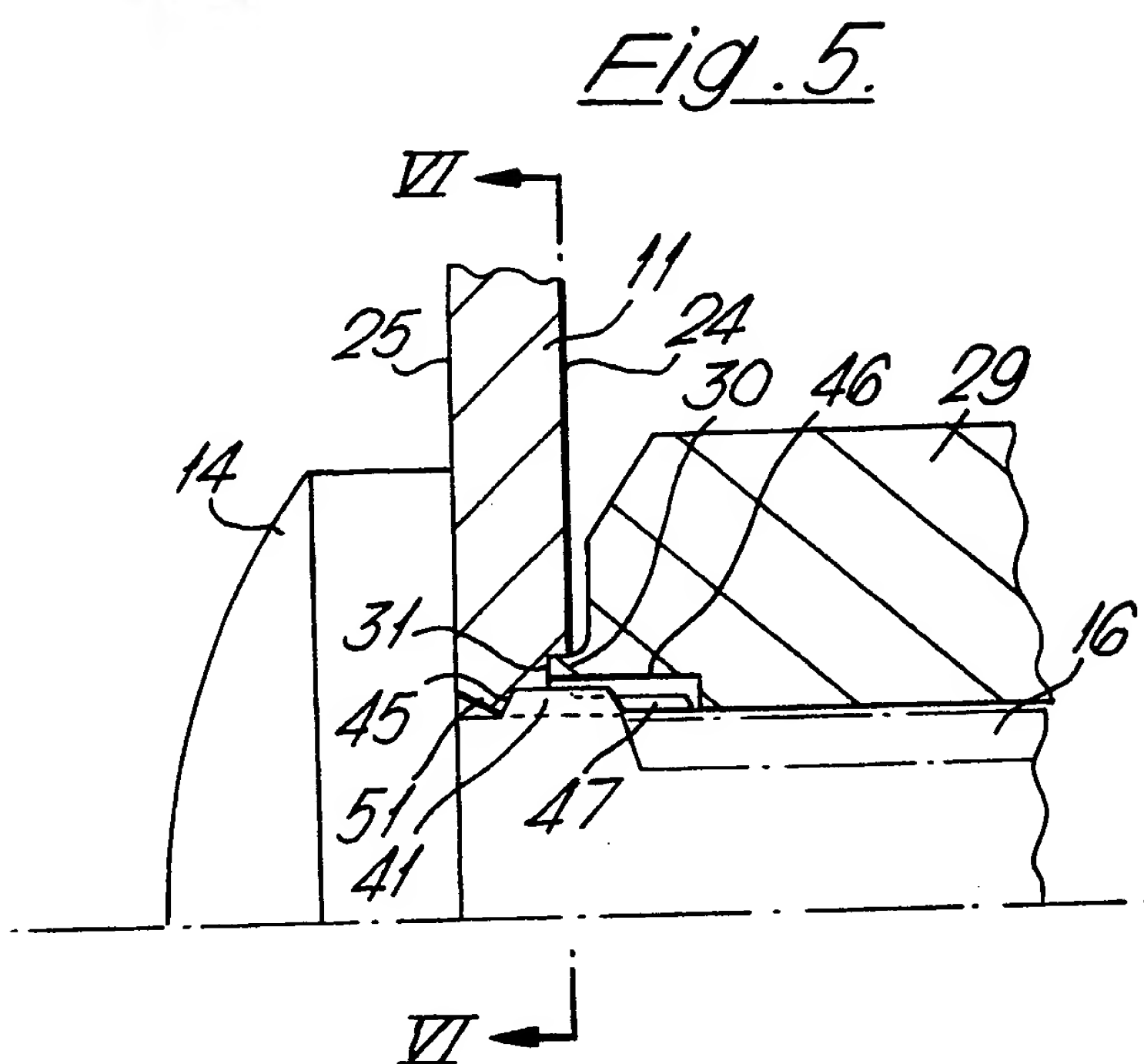
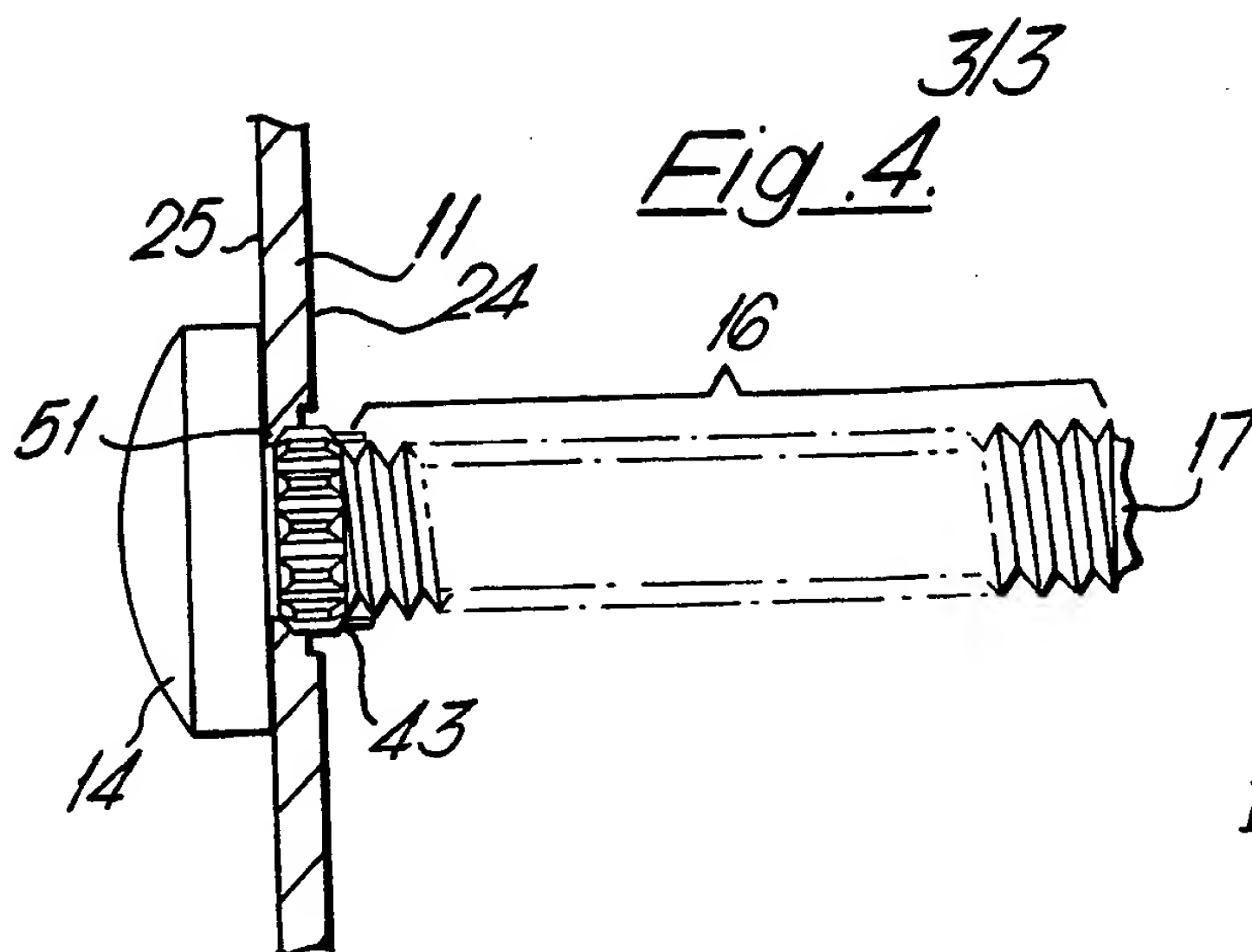
- (57) A pin for use as an earthing stud on a panel 11 comprises a head 14, a knurled portion 15 separated from the head by a groove 23, a threaded portion 16, a breakneck 17 and a

gripping portion 18. The pin is inserted through a preformed hole in the panel and the gripping portion 18 is gripped and pulled by the jaws 27 of an installation tool. The knurled portion 15 is pulled into the panel and bites into it, the reaction to the pull being applied to the panel around the hole by the end face of a narrow annular nose tip rim 30. This reaction forces material of the panel to enter the groove 23 to assist in locking the pin to the panel. The gripping portion 18 is then broken off, to leave the threaded portion 16 projecting from the panel, and mechanically and electrically connected to it.



The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.





SPECIFICATION

Electrically conductive pin and method of installation thereof

The invention relates to an electrically conductive pin and to a method of installation thereof in an electrically conductive panel to enable an electrical connection to be made thereto.

The invention provides in one of its aspects an electrically conductive pin for installation in a preformed hole in an electrically conductive panel to enable an electrical connection to be made thereto, which pin comprises, in order along its length:—

- 15 a head;
- a knurled portion;
- a threaded portion;
- a weakened portion; and
- a gripping portion;

20 the arrangement being such that, when the pin is inserted through a preformed hole of suitable dimensions, and the gripping portion is gripped and pulled with respect to the panel,

25 the knurled portion is forced to enter the hole and thereafter the gripping portion breaks off at the weakened portion,

30 the interengagement of the knurled portion with the wall of the hole providing both electrical and mechanical connection between the pin and the panel,

and the threaded portion is thereby left protruding from the panel to enable an electrical connection to be made thereto.

35 Preferably the knurled portion comprises at least one first portion which, when the knurled portion has been forced to enter the hole to engage the wall thereof as aforesaid, resists rotation of the pin, and at least one second portion which, when the knurled portion has been forced to enter the hole to engage the wall thereof as aforesaid, resists withdrawal of the pin from the panel in the direction opposite to that of its entry.

40 Preferably the or each first portion is provided by a side wall of a rib or spline. Preferably the or each second position is provided by an end face of a rib or spline. In a preferred embodiment, the knurled portion comprises a plurality of ribs or splines, side walls of which provide the aforesaid first portions and end faces of which provide the second portions.

50 The invention also provides a method of installation an electrically conductive pin as aforesaid in a preformed hole in an electrically conductive panel, which method includes the steps of:—

inserting the pin through the hole so that at least the gripping portion protrudes from one face of the panel;

60 gripping the gripping portion and applying a pull thereto to pull the knurled portion into the hole as aforesaid whilst supporting the reaction to the pull on a zone of the said face of the panel around and adjacent the hole,

and using the reaction force on the panel to

65 assist in deforming material from the panel into interengagement with the knurled portion of the pin.

70 Preferably the method includes the step of deforming part of the material of the panel adjacent the hole wall into engagement with the said end faces of the ribs or splines by virtue of the aforesaid reaction force on the panel.

The invention includes an electrically conductive pin as aforesaid which has been installed in an electrically conductive panel by a method as aforesaid.

80 A specific embodiment of the invention will now be described by way of example and with reference to the accompanying drawings, in which:—

Figure 1 is a side elevation of a pin;

Figure 2 shows a pin initially inserted through the hole and about to be gripped and pulled;

85 Figure 3 shows the pin at the end of the pulling stage;

Figure 4 shows the installed pin with the gripping portion broken off;

Figure 5 is an enlargement of part of Figure 3, and on the line V—V of Figure 6; and

90 Figure 6 is a cross-section taken on the line VI—VI of Figure 5.

In this example the pin 10 is intended to provide an earthing stud for an electrically conductive metal panel 11. The panel has a preformed circular hole 12 through it, and the panel is painted on both sides and throughout the hole wall 13 with a paint which is not electrically conductive.

100 The pin is of generally circular symmetry about its longitudinal axis and comprises, in order along its length, an enlarged head 14, a knurled portion 15, a threaded portion 16, a weakened portion in the form of a breakneck 17, and a gripping portion 18 formed with annular grooves 19 and lands 21. The knurled portion 15 carries deformations which in this example comprise axially extending ribs 41 and grooves 42. The knurled portion has a larger maximum diameter (over the rib crests) than any other part of the pin except the head 14. Between the knurled portion 15 and the head 14 is a recess in the form of an annular groove 23, adjacent the head 14.

115 The ribs 41 have side walls 43, sloping leading end faces 44 and sloping trailing end faces 45 (the terms "leading" and "trailing" are used with respect to the direction of entry of the pin into the panel hole; the leading end faces 44 enter the panel first). The trailing end faces 45 of the ribs form one side of the groove 23 the other side being formed by the radially inward part of the underface of the head 14. Although the annular groove 23 has been referred to as a recess, in fact the diameter of the bottom of the groove is not less than the crest diameter of the threaded portion 16.

125 The pin is a unitary structure and is advantageously formed by a rolling process.

In use, the dimensions of the pin 10 in relation to those of the hole 12 pre-selected so that the

diameter of the hole 12 is less than the outside diameter of the knurled portion 15 over the crests of the ribs but greater than that of the crests of threaded portion 16. The pin is first inserted into the hole (as illustrated in Figure 2) so that at least the gripping portion 18 protrudes from the front face 24 of the panel. Because of the relative dimensions involved, the pin will enter the back face 25 of the panel as far as, but no further than, the leading end faces 44 of the ribs, so that a substantial part of the threaded portion 16 also protrudes from the front face 24.

In order to pull the knurled portion 15 of the pin into interengagement with the hole wall 13, the pulling portion 18 of the pin is gripped and pulled by a suitable pulling tool 26, which is illustrated schematically in Figures 2 and 3. Essentially the tool 26 comprises a pair of jaws 27 which can be closed to grip the pulling portion 18 of the pin by interengagement with the grooves 19 and lands 21 thereon, and which also can be retracted with respect to the housing 28 of the tool, by the operation of the tool (which may be manually, pneumatically or hydraulically powered). The forward end of the housing 28 carries a nose 29 with a forwardly projecting annular rim tip 30 which is relatively narrow and has a flat annular end face 31. The rim surrounds a circular mouth 46 which is of sufficient dimensions to accept with clearance the knurled portion 15 of the pin, as illustrated in Figure 5.

The dimensions of annular end face 31 are such that it contacts the face 24 of the panel on an annular zone around and adjacent the end of the hole 12. The reaction to the tension exerted by the jaws 27 on the gripping portion 18 of the pin is supported, through the nose tip face 31, on the aforesaid zone of the panel face 24. As the tension on the pin increases, the knurled portion 15 is progressively forced into the hole 12. The ribs of the knurled portion cut into the panel around the hole wall and deform material therefrom. At least part of this material is accommodated in the grooves between the ribs.

Depending on the relative dimensions of the knurled portion and the hole wall, a greater or lesser quantity of the panel material may be pulled out of the hole, as illustrated at 47 in Figure 3. If this quantity is relatively large, the material will be confined by contact with the interior of the mouth 46 of the nose tip.

As the pulling tool 26 continues to operate, the increasing tension on the pin produces an increasing reaction force, through the end face 31 of the rim, on a relatively narrow annular zone of the panel front face 24 around and adjacent, but slightly spaced radially outwardly from, the opening of the hole 12 in the front face 24 of the panel (the diameter of the hole 12 is less than the outside diameter of the knurled portion 15, so that the ribs cut into the panel, whereas the mouth 46 is of a larger diameter, to accommodate the knurled portion 15).

This increasing reaction force has the effect of

65 deforming part of the material of the panel adjacent the hole wall, substantially in an annular zone opposite the annular face 31, backwardly of the sheet. With the present example, this occurs before the pin has been pulled sufficiently far into the sheet for the underface of the pin head 14 to contact the back face 24 of the panel, so as the pin head advances towards the panel it forces this deformed material radially inwardly into the annular groove 23. With a stronger and or thicker panel, the pin head might contact the panel before the reaction force has reached a high enough value to cause the deformation just described, in which case the material is deformed directly into the groove 23. Figure 3 shows the position with the pin head in contact with the panel rear face 24.

Enlarged Figure 6 illustrates how material 52 from the panel has filled the grooves 42 so that the side walls 43 of the ribs are in tight engagement with the panel and resist rotation of the pin relative to the panel.

Enlarged Figure 5 illustrates how material 51 from the panel has been deformed into the grooves 23 so that the trailing end faces 45 of the ribs 41 resist withdrawal of the pin from the sheet in the direction opposite to that of its entry.

As the tension in the pin increases still further, the breakneck 17 fractures and the gripping portion 18 and the tool can be removed, leaving the fully installed pin as illustrated in Figure 4. This provides a threaded stud which is mechanically and electrically connected to the panel, and which can be used to make an electrical connection to the panel (e.g. for earthing the panel) by means of one or more nuts screwed on to the stud.

It will be noted that the interengagement of the ribs and grooves of the knurled portion 15 with the panel hole wall provides both good electrical connection and good mechanical connection. The interengagement of the side walls of the longitudinal ribs and grooves provide good resistance to rotation of the installed pin in the hole, thereby facilitating tightening one or more nuts on the threaded portion of the pin. The biting of the ribs into the hole wall, which is similar to a broaching action, effectively cuts through and/or removes the paint from the hole wall, so that good electrical contact is made and maintained between the pin and the panel. The interengagement of the rear end faces 45 of the ribs 41 with the panel material deformed into the groove 23 provides good resistance to push-out of the pin from the panel in the opposite direction to its entry therinto.

The invention is not restricted to the details of the foregoing example. For example, the configuration of the deformations on the knurled portion could be other than as described. The gripping portion of the pin may not be provided with grooves and lands but may be cylindrical, in which case the jaws of the pulling tool are provided with suitable teeth to bite into and grip the gripping portion.

CLAIMS

1. An electrically conductive pin for installation in a preformed hole in an electrically conductive panel to enable an electrical connection to be made thereto, which pin comprises, in order along its length:—
 - a head;
 - a knurled portion;
 - a threaded portion;
 - a weakened portion; and
 - a gripping portion;
 the arrangement being such that, when the pin is inserted through a preformed hole of suitable dimensions, and the gripping portion is gripped and pulled with respect to the panel, the knurled portion is forced to enter the hole and thereafter the gripping portion breaks off at the weakened portion, the interengagement of the knurled portion with the wall of the hole providing both electrical and mechanical connection between the pin and the panel, and the threaded portion is thereby left protruding from the panel to enable an electrical connection to be made thereto.
2. A pin as claimed in Claim 1, in which the knurled portion comprises at least one first portion which, when the knurled portion has been forced to enter the hole to engage the wall thereof as aforesaid, resists rotation of the pin, and at least one second portion which, when the knurled portion has been forced to enter the hole to engage the wall thereof as aforesaid, resists withdrawal of the pin from the panel in the direction opposite to that of its entry.
3. A pin as claimed in Claim 2, in which the or each first portion is provided by a side wall of a rib or spline.
4. A pin as claimed in Claim 2, in which the or each second portion is provided by an end face of a rib or spline.
5. A pin as claimed in Claim 2, in which the knurled portion comprises a plurality of ribs or splines, side walls of which provide the aforesaid first portions and end faces of which provide the second portions.
6. A pin, substantially as hereinbefore described with reference to, and illustrated in, the accompanying drawings.
7. A method of installing an electrically conductive pin as claimed in any of the preceding claims in a preformed hole in an electrically conductive panel, which method includes the stages of :—
 - inserting the pin through the hole so that at least the gripping portion protrudes from one face of the panel;
 - gripping the gripping portion and applying a pull thereto to pull the knurled portion into the hole as aforesaid whilst supporting the reaction to the pull on a zone of the said face of the panel around and adjacent the hole,
 - and using the reaction force on the panel to assist in deforming material from the panel into interengagement with the knurled portion of the pin.
8. A method as claimed in claim 7, of installing a pin as claimed in Claim 5, including the step of deforming part of the material of the panel adjacent the hole wall into engagement with the said end faces of the ribs or splines by virtue of the aforesaid reaction force on the panel.
9. A method of installing an electrically conductive pin, substantially as hereinbefore described with reference to, and illustrated in, the accompanying drawings.
10. An electrically conductive pin as claimed in any of Claims 1 to 6 which has been installed in an electrically conductive panel by a method as claimed in Claim 7.
11. An electrically conductive pin as claimed in Claim 5 which has been installed in an electrically conductive panel by a method as claimed in Claim 8.
12. The combination with an electrically conductive panel of an electrically conductive pin installed therein, substantially as hereinbefore described with reference to, and illustrated in, the accompanying drawings.

